# Space Weather Technical Forecast

Issued on Thursday, 15 August 2024 at 01:18 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

**Space Weather Forecast Headline: M-class flares expected, a chance of X-class flares. A chance of S1/Minor radiation storming.**

## Analysis of Space Weather Activity over past 24 hours

**Solar Activity:** Solar activity has been High with four M-class flares and a single X-class flare observed in the past 24 hours, the latter of which peaked at X1.1 originating from AR3784 in centre disk. There are nine sunspot regions visible on the disc. AR3784 in centre-north is the largest and most active region and has significant magnetic complexity, with the trailing portions loosely connected to a large delta central spot with a somewhat unusual configuration. AR3780 situated in the southwest remains large, it retains a complex magnetic structure with at least one delta spot around the large and compact central spot, although is becoming harder to analyse as it approaches the western limb. All other spots are currently small and simple.

A faint, partial halo CME associated with the X1.1 flare at 14/0640UTC is likely to have an Earth-directed component. ENLIL analysis predicts that this CME will arrive at Earth early on Day 3 (17 Aug); however, confidence is low due to the faintness of the CME.

**Solar Wind / Geomagnetic Activity:** Solar wind parameters measured at L1 by DSCOVR/ACE were indicative of waning CME magnetic cloud conditions, with perhaps an embedded weak transient during the early hours of the 14th Aug. Solar wind speeds were initially slightly elevated, around 460km/s, and barring some slight variation initially have been on a slow declining trend to current background levels around 390km/s. Density was around average but above between 14/0200-0500UTC, with a peak of 16 ppcc observed at 14/0238 UTC. The Interplanetary Magnetic Field, Bt, was largely weak, below 8nT, but touched into moderate 8-9nT towards the end of the period. The north-south component, Bz, varied weakly, with fluctuations between +8/-6nT. Phi angle was initially mostly positive (away from the Sun) before rotating to mostly negative (toward the Sun) after 14/0800 UTC. Geomagnetic activity ranged between Quiet to Active levels (Kp 1-4).

**Energetic Particles / Solar Radiation:** High energy (greater than 10 MeV) proton flux observed by GOES18 remained at background below the S1 Minor Radiation Storm threshold. High energy electron flux (greater than 2MeV) observed at GOES16 were predominantly at background levels. The 24-hour fluence showed a slight upwards trend but was still well below the Active threshold, with 2.72e6 integrated pfu observed at 15/0000 UTC.

## Four-Day Space Weather Forecast Summary

**Solar Activity:** Moderate to High solar activity is forecast, with M-class flares expected and a chance of an isolated X-class flare.

**Solar Wind /Geomagnetic Activity:** A faint, partial halo CME associated with the X1.1 flare at 14/0640UTC is predicted to arrive at Earth early on Day 3 (17 Aug); however, confidence is low due to the faintness of the CME. The fast wind from CH58/- is expected to mostly pass north of the Earth-Sun line, with no major enhancement expected.

Geomagnetic activity is expected to remain Quiet to Unsettled (Kp 0-3) at first with a chance of Active (Kp 4) intervals. Following the arrival of the CME on Day 3 (17 Aug), G1-G2/Minor-Moderate storms

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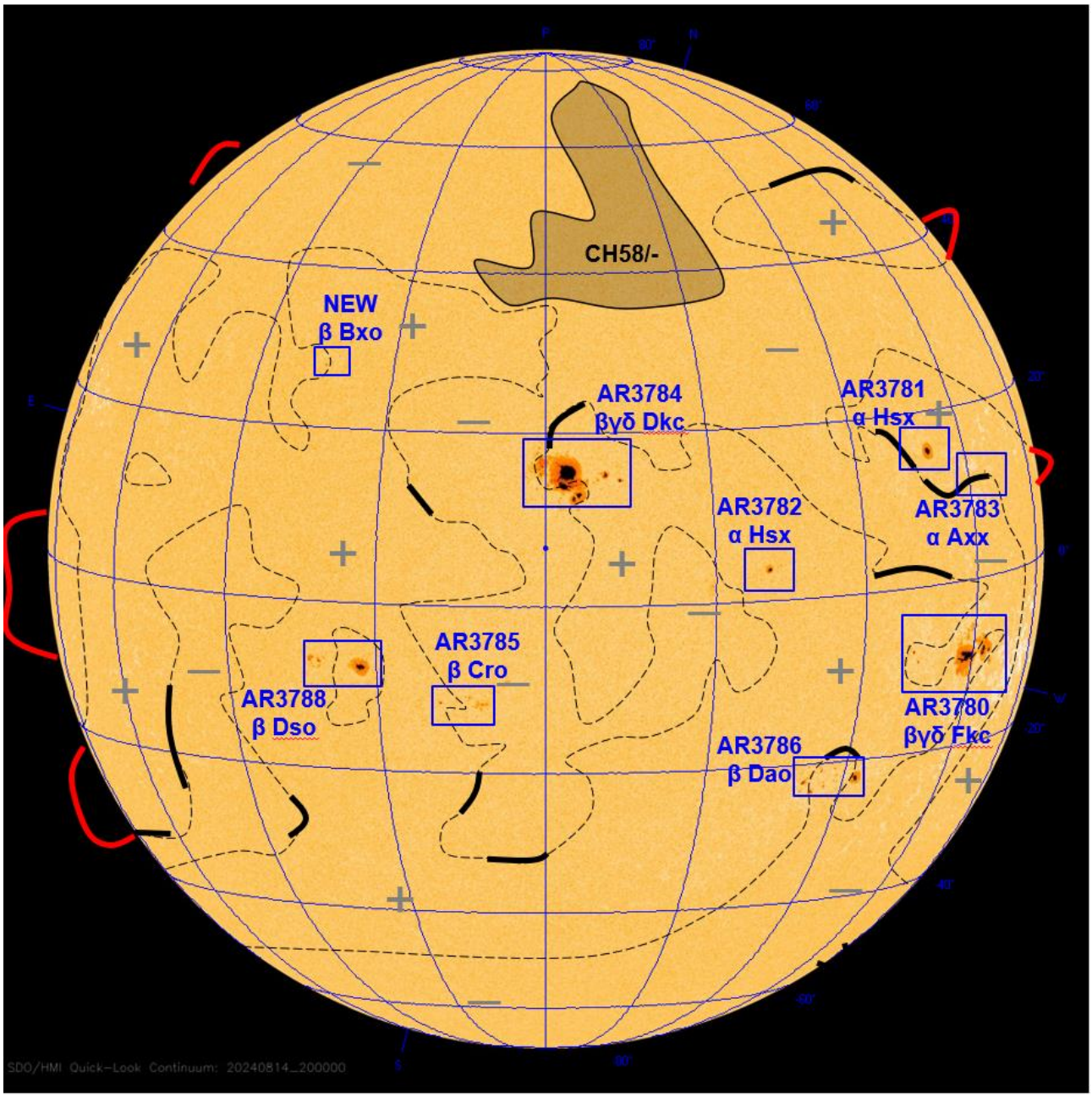
are likely, with only a slight chance of G3/Strong storm intervals, although this has low confidence.

**Energetic Particles / Solar Radiation:** A heightened risk of flare activity brings a chance of reaching/exceeding the S1 Minor Radiation storm level should any significant flares occur from active regions in the western hemisphere, though this risk reducing slightly through Day 1 (15 Aug). The high energy electron flux is forecast to be at mostly background levels. The associated 24-hour fluence is expected to remain below the Active threshold (1e8 integrated pfu).

**Figure 1. Solar Analysis Valid 14/2000UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

A faint, partial halo CME associated with the X1.1 flare at 14/0640UTC is likely to have an Earth-directed component. ENLIL analysis predicts that this CME will arrive at Earth early on Day 3 (17 Aug); however, confidence is low due to the faintness of the CME.

The fast wind from negative coronal hole 58 is largely expected to pass north of the Earth-sun line, with no major enhancement expected. This is also a recurring feature, and since no significant enhancement was observed in the last rotation, its overall effect is expected to be low. Therefore, until the arrival of the aforementioned CME, solar winds should remain slow and ambient or perhaps slightly elevated at times.

Geomagnetic activity is expected to remain Quiet to Unsettled (Kp 0-3) at first with a chance of Active (Kp 4) intervals. Following the arrival of the CME on Day 3 (17 Aug), G1-G2/Minor-Moderate storms are likely, with only a slight chance of G3/Strong storm intervals, although this has low confidence. Conditions then expected to decrease back to background through Day 4, in the absence of any further CME enhancement.

| Geo-Magnetic Storm | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Minor or Moderate | G1 to G2 | No | 5 | 5 | 70 | 30 |
| Strong | G3 | No | 1 | 1 | 15 | 5 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

## Geomagnetic Activity - Earthbound Coronal Mass Ejections

| Date/time 21.5R (UTC) | Halo: Full or Partial | Source | Source Location | Estimated Speed | Estimated Arrival Time | Comments |
|---|---|---|---|---|---|---|
| 14/1400 | Partial | X1.1 flare | AR3784 | 610 km/s | 17/0800UTC -6hr, +12hr | Low confidence due to faint CME |

**Figure 2: MOSWOC ENLIL showing CME arrival on 17 Aug**

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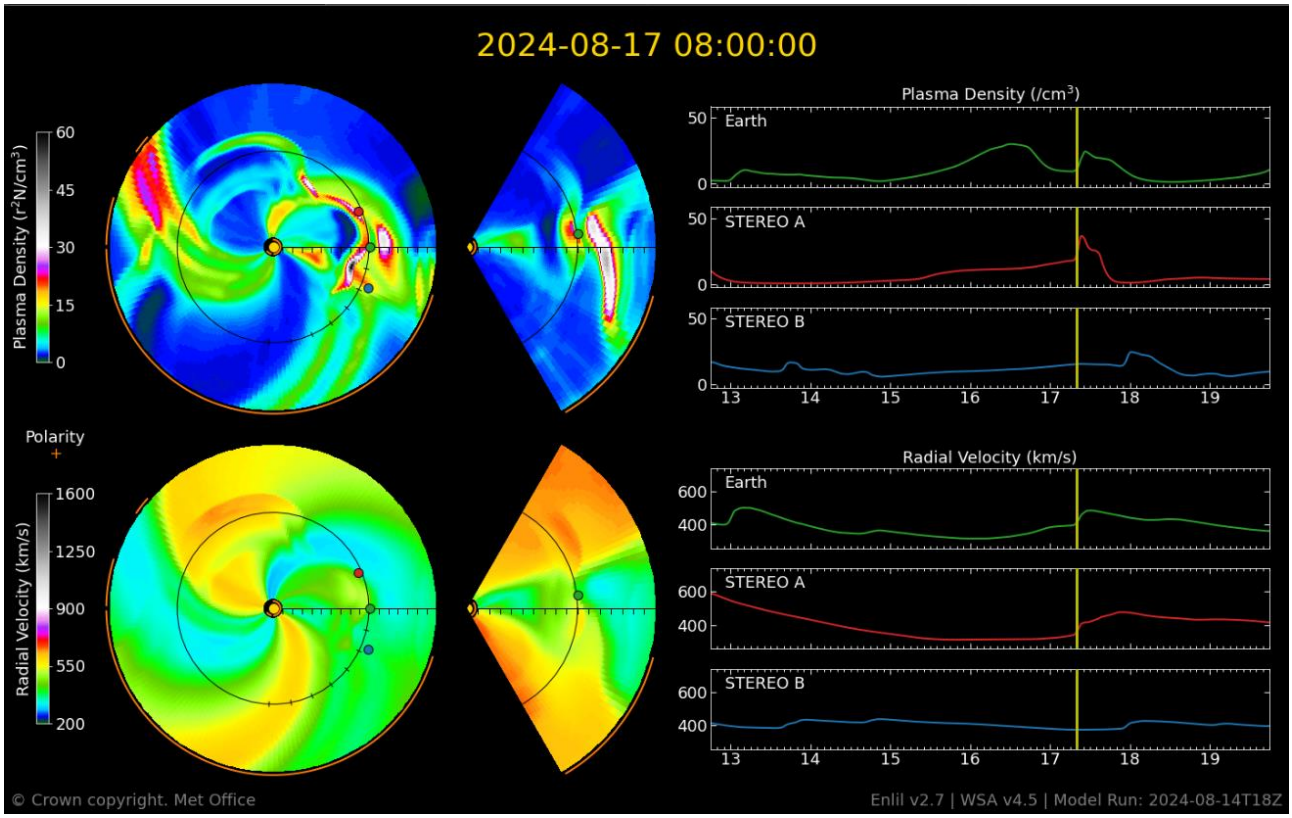


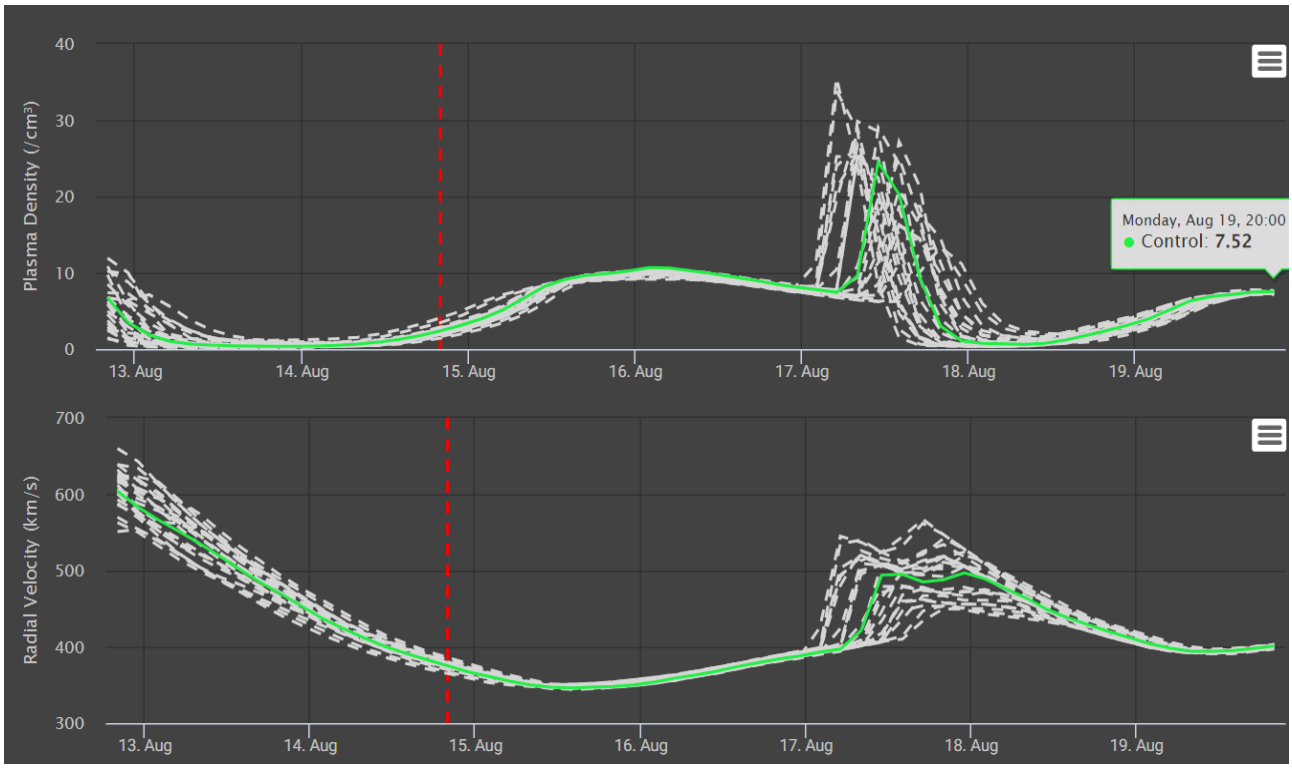


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## Radio Blackouts - X-Ray Flares:

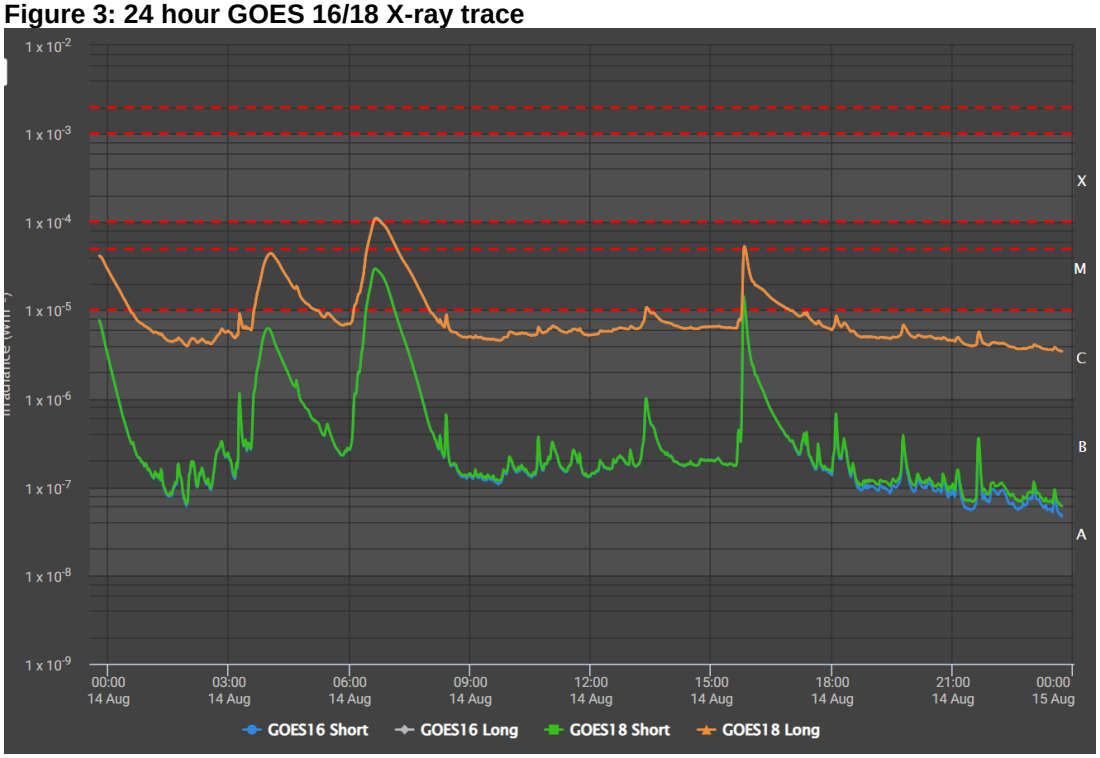
Solar activity has been High with four M-class flares and a single X-class flare observed in the past 24 hours, the latter of which peaked at X1.1 originating from AR3784 in centre disk.

There are nine sunspot regions visible on the disc. AR3784 in centre-north is the largest and most active region and has significant magnetic complexity, with the trailing portions loosely connected to a large delta central spot with a somewhat unusual configuration. AR3780 situated in the southwest remains large, it retains a complex magnetic structure with at least one delta spot around the large and compact central spot, although is becoming harder to analyse as it approaches the western limb. All other spots are currently small and simple.

Solar activity is expected to remain Moderate to Strong with Further M-class flares expected and a chance of isolated X-class flares. There remains a chance of an S1 Proton Storm should any notable flares occur, most likely from AR3777 or AR3780.

| X Ray Flares<br>Probability | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC)<br>(%) | Day 2 (00-24 UTC)<br>(%) | Day 3 (00-24 UTC)<br>(%) | Day 4 (00-24 UTC)<br>(%) |
|---|---|---|---|---|---|---|
| Active | R1-R2 M Class | Yes | 80 | 80 | 80 | 80 |
| Very Active | R3 to R5 X Class | Yes | 25 | 25 | 25 | 25 |

**Figure 3: 24 hour GOES 16/18 X-ray trace**

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## Solar Radiation Storms - (High Energy Protons):

High energy proton flux, as observed by GOES-18, was at background throughout the period. Any further notable flares originating near the western limb will bring a chance of exceeding the S1 Minor Radiation storm level. The risk mainly from AR3780 and AR3777 currently in the western hemisphere, though this reducing by through Day 1(15 Aug) as AR3777 rotates further beyond the western limb.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 25 | 20 | 20 | 20 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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### High Energy Electrons Event (≥ 2MeV):

High energy electron flux, as observed by GOES-16, is currently at background. The recent Strong and Severe geomagnetic storming on 12 Aug may see electron flux at GEO increase in time to moderate or even high levels given the potential for electron transfer from currently more highly charged regions below GEO, though this remains a low probability with little appreciable increase in electron counts having recently been observed. Should any enhancement in flux levels occur in the next few days, CME influence from Day 3 (17 Aug) will likely return electron flux to background.

The associated 24hr electron fluence is therefore currently expected to remain below Active (1e8 integrated pfu) levels throughout but with reduced confidence.

| GEO Electron Environment<br>Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC)<br>(%) | Day 2 (00-24 UTC)<br>(%) | Day 3 (00-24 UTC)<br>(%) | Day 4 (00-24 UTC)<br>(%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ 2 MeV ≥ $1x10^8$** | No | 10 | 10 | 10 | 1 |
| **Very Active** | **≥ 2 MeV ≥ $1x10^9$** | No | 1 | 1 | 1 | 1 |

**Figure 5: MOSWOC REFM fluence observations, forecast and recurrence.**

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